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the fungus must remain in that genus. Several other species of *Karschia* are numbered among about 400 fungi that grow on lichen thalli, and a study of each of these would be of special interest and value.

The author states that his study of these two fungi proves that there can be no sharp separation of the many fungi known to grow on lichens into parasites, parasymbionts, and saprophytes, since a single species may show all three conditions at various times in its life history. He thinks that further studies would demonstrate that most of the fungi found growing on lichens are not purely parasitic, but parasymbiotic and often saprophytic as well. In this he is probably correct, and further research along this line would add much to our knowledge of the biological relations of these fungi. The conclusion is also reached that these studies tend to obliterate the line of demarkation between lichens and other fungi. This is true, but a considerable number of botanists have already concluded that the biological distinction between lichens and other fungi should not serve longer to maintain the lichens as a distinct group in any general classification of plants.

Some other fungi growing on lichens were examined briefly, without adding materially to the important results secured in the study of the two species considered above.—BRUCE FINK.

**Evolution of vascular structures.**—In a bulky memoir of 325 pages, CHAUVEAUD[25] expounds his view of the evolution of vascular bundles as they are found in different groups of plants. He finds himself in disagreement with the current notion of the stele as a morphological concept of first importance, and returns to the earlier view of a vascular bundle as the unit. With him, in fact, a vascular bundle is either a xylem or a phloem group, and these are arranged according to one of six "*dispositions*": (1) centric, corresponding to protostele; (2) excentric, with the xylem group more or less flattened; (3) alternate, represented by a root with diarch structure; (4) intermediate, as seen in the hypocotyl of some plants; (5) superposed, a circular row of collateral bundles; and (6) peripheral, represented by amphivasal bundles such as are seen in monocotyledonous stems. Thus what most writers call a protostele is by CHAUVEAUD, as well as earlier writers, regarded as the most primitive condition; the alternate arrangement of xylem and phloem exhibited by all roots is the next main step in evolution; and from this root structure are to be derived the conditions seen in the stems of gymnosperms and angiosperms. It will be seen that this mode of derivation lays a heavy responsibility on the hypocotyl, for this transitional region is considered to reveal the stages in evolution leading to the stem structure of all the higher plants. One must swear entire allegiance to the recapitulation theory when adopting this scheme, although certain difficulties appear, for instance, in connection with the origin of amphivasal bundles. To some it may appear an unnecessarily round-about plan to derive a circle of collateral bundles from a protostele *via* the root, when direct routes have been proposed which do not violate the doctrine of recapitulation. Moreover, it would be interesting to see how the stele of *Osmunda* could be derived according to the new method, inasmuch as in ferns the evolution is said (p. 271) not to proceed further than the third or alternate disposition.

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[25] CHAUVEAUD, G., L'appareil conducteur des plantes vasculaires et les phases principales de son évolution. Ann. Sci. Nat. Bot. IX. **13**:113–438. *figs. 218*. 1911.

The memoir is divided into three parts, in the first of which a fairly complete historical résumé is given. This is rendered more valuable by the grouping of the papers under six headings. It is to be regretted that a number of errors have crept into the citations. The second part is devoted to a summary of the author's earlier researches in this field; while the third part contains an account of his new observations, extending over a wide range of vascular plants, including a large number of dicotyledons, though the critically important cases found in his group "vascular cryptogams" are represented only by *Pteris cretica*.—M. A. CHRYSLER.

**Fermentation.**—Experiments of HARDEN and NORRIS[26] confirm the work of other investigators according to whom many yeasts which ordinarily do not ferment galactose acquire the property of fermenting that sugar by being cultivated for a time on a medium containing it. The authors further show that the juice from such a yeast is also capable of fermenting galactose, and that the addition of phosphates to the fermentation-mixture causes an acceleration of fermentation similar to that observed in mixtures of glucose, fructose, or mannose and yeast juice on the addition of phosphates. As in the case of these hexoses, the phosphate is in the form of an organic compound from which it is not precipitated by magnesium citrate mixture. Small quantities of sodium arsenite also accelerated fermentation.

Regarding the constitution of the compound formed when a phosphate is added to a fermenting mixture of yeast juice and a hexose, three views have been proposed. According to HARDEN and YOUNG it is a hexose-phosphate containing two phosphoric acid residues. LEBEDEW holds that the compound contains only one phosphoric acid residue, basing his view on the fact that the ozazone obtained from it has only a single phosphoric acid residue. The third view is that of IWANOFF, who considers the compound a triose phosphate. In a recent paper, purely chemical in its content, but of great biological interest in so far as it clears up part of the mechanism of fermentation of sugars by yeast juice, YOUNG[27] presents further evidence to show that the compound is

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[26] HARDEN, A., and NORRIS, R. V., The fermentation of galactose by yeast and yeast juice (Preliminary communication). Proc. Roy. Soc. London B **82**:645–649. 1910.

[27] YOUNG, W. J., Ueber die Zusammensetzung der durch Hefepresssaft gebildeten Hexosephosphorsäure. II. Biochem. Zeitschr. **32**:177–188. 1911.